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Language, multilingualism, biocultural diversity and sustainability

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Abstract. This paper examines the relationship between multilingualism, considered both as an environmental and personal phenomenon, and biocultural diversity, a biological, cultural and linguistic complex, each of which are essential components of the characteristics of resilience and transformability that underlie sustainable evolutionary processes. It argues that increasing language mortality and tendencies towards environmental and personal monolingualism put at has a fundamental role to play in the search for new pathways.

Keywords: Environmental and personal multilingualism, biocultural diversity, vitality, knowledge building, sustainability

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***Perspective**: Theoretical vision*

***Fields**: Human sciences*

***Issues**: Sustainable language and knowledge - Local knowledge and ecological consciousness*

1. Introduction

The sustainability of life depends on language as a unique means of creating the flow and the processing of information that permit both biological processes and, in terms of natural, human language, cultural practices that involve reflection on and action in the world. In a multilingual world a multiplicity of languages performs this role. Language is a biocultural evolutionary system and each single language is a particular example of the immense diversity that such a system can generate.

The description and analysis of both the characteristics and the functions of language have often largely focussed on the relationship between language and communication, but I would argue that it is at least equally, or even more, important to consider the relationship between language and the knowledge-building processes on which life is founded. How and what knowledge is built depends on the language or languages used to build it. Moreover, the way in which knowledge is used in acting and interacting in the world is equally dependent on language. There is thus an inextricable relationship between the sustainability of life, ways of knowing, ways of being and language.

Languages are cognitive tools. Within the vast spectrum of human multilingual diversity, each language has a special way of creating the processes of sense making and the texture of meanings by which its users live. If all the roughly 7000 languages existing today are solutions to the problem of giving meaning to the world, it is important to keep in mind that the possible solutions are infinite and that the roughly half a million languages (Pagel, 2000) that have existed since the first natural languages were born about 220,000 years ago have built very different solutions to those present today.

Every language is inevitably characterized by relativism because it naturally opens particular horizons and puts limits on what its users are able to conceive and express. The horizons and limits are very different from one language to another. Moreover, the ways in which languages evolve constantly involve examples of increase or decrease in codificability - the ability to express certain signifieds through given signifiers - and thus a continuous broadening or narrowing of the language itself and its meaning potential. At the same time, broadening and narrowing are not at all synonymous with enrichment or depletion in absolute terms, but rather examples of differences and changes due to various social, economic and cultural factors. What is important to recognize is that monolingualism leads inevitably to a condition of tunnel vision and thereby to a reduced potential for life and for finding solutions to its problems, in communities as in individuals, and that multilingualism is a natural antidote to this condition.

Multilingualism - the existence of a multiplicity of types and variants of language - can be considered as an environmental or as a personal phenomenon. Environmental multilingualism occurs when, at the level of territories, societies or groups, different languages coexist and are used for reasons of work, study, bureaucratic procedures, tourism, social interaction, recreational, cultural, political and many other types of activities. Personal multilingualism occurs when single individuals use different languages in their everyday lives for a range of purposes. Humans' natural predisposition to language acquisition (Kuhl, Rivera-Gaxiola, 2008) means that in contexts that are propitious, people develop spontaneously and inevitably a multilingual competence. At a global level environmental multilingualism has always been the norm, driven by natural, evolutionary processes. Recently, however, developments such as the emergence of nation states, the spread of colonialism, a particular vision of the globalisation of human activity and the hegemonic use of particular languages in given (for example,

scientific) fields have tended to impose or encourage models based on a presumed normality or necessity of environmental and personal monolingualism.

2. The evolution of multilingual diversity

Natural, human, language has long historical and cultural roots that explain the many differences that exist within all its manifestations as individual language systems. When Homo sapiens began migrating out of Africa towards other continents about 120,000 years B.C, in all probability natural language had already existed for something like 100,000 years. At that time, the human diaspora was extremely limited compared to that of our more recent history. It is likely that up until the development of the agro-pastoral society the overall population never exceeded 0.1% of current levels (Cavalli-Sforza, Nenozzi, Piazza, 1994). In addition, the groups that formed and spread tended to be limited in number, with usually between 100 and 200 members. Each group founded its own language in order to satisfy its needs in terms of knowledge building, communicating, acting and interacting. When groups became too large to be functional, they split and formed new groups that moved in other directions. Each new group took with it a part of the language of the previous group as the basis for the development of a new language. Over time this fragmenting nomadism resulted in loss of contact with previous groups and led to linguistic drift, the emergence of new dialects and then new languages. It is estimated that after about a thousand years of isolation the various dialects of a given language may have changed so as to reach the point of reciprocal incomprehensibility. When groups came into contact the outcome was a variety of forms of contamination and hybridization and the consequent formation of new varieties of language. In addition, the evolutionary process of adaptation to experience with new circumstances and new technologies led to a constant and highly variable process of enrichment of the different languages that emerged.

This scenario characterized the hundreds of thousands of years of the spread of the society of hunters and gatherers and caused the gradual extension of multilingualism on a global scale, multiplying exponentially the number of languages in the world and creating a kind of diversifying globalisation exactly the opposite of the uniformity generally intended today by many users of the same term. The diversification of natural language thus emerged in the same way as population genetics, with factors such as lineal inheritance, drift, recombination, hybridization and adaptation creating the conditions for new variants that developed as social groups separated. Moreover, a range of selectors - characteristics of the brain and the vocal tract, constraints inherent in the biophysics of natural language and within particular language systems, transitional links that permit or prevent possible transformations - determined the possibility that different variants could take root, spread and consolidate themselves (Evans and Levinson, 2009).

The recent (in terms of human evolution) advent of agro-pastoral societies radically changed this scenario. The kind of permanence based on a stable community brought by this change no longer presupposed the isolation of groups and consequent linguistic fragmentation. Meeting, exchanging and trading became a way of life that gradually spread over increasingly large areas of the globe. Different groups and their languages increasingly came into contact thereby creating the conditions for a world characterized by decreasing environmental multilingualism and increasing personal multilingualism. In this way, the agro-pastoral society reversed the trend toward increasing diversification of natural language in new

families and individual languages and led to a gradual reduction in the range of linguistic diversity in the world.

This process underwent a sharp acceleration with the emergence of nation states in Europe and the concentration of individual languages within their borders, a trend made even more powerful by colonialism, which expanded enormously those borders on an intercontinental level. Even if it is a recent phenomenon and limited to a very short historical period, this model of a geo-political entity and the consequent idea of personal identity defined by membership of a particular state, sanctioned by birth within its borders, is still today very strong and influential. The nation-state is, however, an ideological and political invention that spread in Europe in particular between the eighteenth and nineteenth centuries. On the one hand it allowed a certain kind of political power to establish and extend its control over a given territory, to promote an idea of unity and cohesion within it. At the same time, it undeniably facilitated movements of liberation from the oppression of empires, promoted the self-determination of peoples, the emergence and spread of democratic societies, the acceleration of the processes of industrialization and the construction of the welfare state and educational systems. But, like any ideology, it is based on a mythological construct, an invented tradition (Hobsbawm and Ranger, 1992). The nation-state is a concept based on a modern idea of a country characterized by one territory, one nation, one people and one language, a presumed normality of monocultural and monolingual identity.

A parallel monolingual development can be found in the current and increasing dominance of English in scientific discourse and within research paradigms, perspectives and processes of enquiry. Many reasons can be adduced in explaining such a trend, ranging from Anglophone global ambitions and corporate funding and investment in research and higher education to a need to facilitate collaboration and exchange within the scientific community. The point is not so much why this has happened but rather what are the consequences, what are the risks in terms of tunnel vision, the limited perspectives and the reduction of human meaning potential for problem posing and problem solving. If one of the motives for an ever-larger scale adoption of prestigious languages is the facilitation of communication, at the same time the inevitable consequence is the impoverishment of knowledge-building processes.

3. Levels of diversity

Linguistic theory has often assumed the existence of a universal grammar, and especially of syntactic universals (Greenberg, 1963, Chomsky, 2007) linked to universal cognitive structures, but a comparative study of language families and systems demonstrates how any cases of generalized characteristics are exceptions and absolutely not the norm. Linguistic diversity cannot be explained by reference to cognitive factors universally present throughout humanity. It is rather the product of cultural evolution and follows multiple routes, which form systems that are developed for diversification within an evolutionary landscape based on a principle of adaptation capable of producing a richness of infinite complexity (Evans and Levinson, 2009, Boroditsky, 2009, Fausey, Boroditsky, 2010, Deutscher, 2010, Dediu and Levinson, 2012).

Today, despite a growing rate of language mortality, there is still a huge range of linguistic diversity and radical differences between families and individual systems at the level of phonology, morphology, syntax and processes of signification. In this sense, human language is a natural laboratory of some 7000 experiments in the creation of

possible worlds and linguistic systems that allow their users to inhabit them.

As I write, Ethnologue lists 7106 languages divided into between 300 and 400 families, within which there is such variety between affiliated languages that some of them are very similar while others show very high levels of divergence. Among the families studied, the most numerous is the Niger-Congo family, with some 1545 languages, followed by the Austronesian, with 1257 languages, the Trans-New Guinea with 480 languages, the Sino-Tibetan with 460 languages and the Indo-European, with 445 languages. Each of these families has an estimated time dimension ranging from about 5000 to 9000 years. At the same time there are over 100 languages that are completely isolated, without any demonstrable form of affiliation.

Currently, it is estimated that every year six languages become extinct. According to Ethnologue, over 80% of the languages listed are used by populations with less than 100.000 members and nearly 40% have populations of less than 10.000 and therefore face imminent extinction. Today what remains is less than 2% of the entire range of human linguistic diversity, of which we have a description with grammars and dictionaries for less than 10%. Consequently, when we try to analyse natural language we rely on a very small number of examples compared to its real wealth and potential. Furthermore, even today new languages continue to be discovered and each new discovery reveals hitherto unknown and unexpected features that constitute the linguistic systems. The increasing loss of linguistic diversity, like that of biological species, together with our ignorance of much of existing and previous human language, drastically reduces our understanding of what is the full range of possibilities of life and natural language and thus our ability to exploit those possibilities within sustainable human trajectories.

If we consider some of the various dimensions of the diversity that emerges during the evolution of natural language, the first feature is that there may be use or no use of articulatory-auditory channel, a feature easily considered universal, but not present in sign languages, of which Ethnologue documents 138 examples, while recognising that there exist hundreds more. Many examples of this language have been developed independently and with quite different characteristics throughout the world. Some believe that they were evolutionary precursors of speech and the discovery of mirror neurons provides some support for this idea (Bellugi, Klima, Hickok, 2010). Another hypothesis is that natural language evolved as a hybrid system based on both hands and mouth and then developed very flexible and variable modes of interaction between a predominantly oral language and the body language that accompanies it (Sandler et al., 2005, Sandler, Lillo-Martin, 2008).

In languages that rely on the articulatory-auditory channel, the basic elements are phonemes, the sounds that correspond to certain physical frequencies, which combine to form words. However, there are huge differences between systems with regard to the number of phonemes and distinctions between phonemes and sequences of phonemes and the ranges of contrastive sounds are completely different. Within known linguistic systems, the number of phonemes used varies from a minimum of eleven to a maximum of 144. Moreover, there are equally enormous differences in the relationship between phonology and spelling in opaque and transparent languages that demonstrate low or high levels of correspondence between spoken and written forms.

In the early stages of the evolution of natural language, it seems likely that there emerged a number of individual signifiers, or proto-words, with or without specific

morphological characteristics, to label objects and name actions. Subsequently, syntax developed, a process by which particular signifiers assume combinatorial features such as to allow the construction of a repertoire of infinite utterances from a finite number of signifiers. Gradually sets of rules or conventions for combining signifiers were built and shared in order to make given utterances meaningful and understandable to members of the group that shared the same language. Syntax is a clear indicator of the construction of a lexico-grammar by a brain predisposed to cognition, a process of creating cerebral connections and interweaving signifiers and signifieds.

In general, we can say that most of the languages known today manifest their own morphology - the way in which their signifiers are formed - and their own syntax - the way in which individual signifiers are put into relationship. While these features can be considered the building blocks of language, morphological and syntactic changes are potentially infinite and constantly evolving. If the word can be identified as the type of signifier universally present in every natural language, it is however not at all easy to arrive at a definition of what constitutes a word. Languages can have or not have morphologies to form different classes of words. In many cases, although we cannot exclude the existence of classes of words in many languages, these are absolutely unrelated to typical categories of other families such as the Indo-European (nouns, adjectives, verbs, adverbs, pronouns, prepositions and conjunctions) or are characterized by utterly different morphologies. Similarly, there may be syntactic structures at the basis of building units such as phrases and sentences, or these may be completely absent. Such an immense spectrum of structural differences means that there is an equally vast range of processes of perception and cognition, of ways of constructing concepts based on spatial, temporal, agency and interpersonal relationships and of considering the characteristics, interactions and transformations that make up human world views.

4. Diversity and vitality

Territories with a high rate of biodiversity tend to a corresponding level of linguistic diversity. Today many believe that there is not only a correlation but also a relationship of causality between the two. For example, much knowledge vital to the maintenance of biodiversity is encoded in local indigenous languages in very limited areas and with very small populations. The death of a language is the loss of prerequisites for maintaining biodiversity, the loss of an inheritance, or demonstration of the potential for the linguistic, cultural and biological diversity of life (Crystal 2000). Many local languages contain numerous lexical distinctions concerning natural phenomena that are entirely absent in other, more prestigious and widespread languages, thereby demonstrating a capacity of their speakers to know and act in harmony with an environment, its changes and evolution, something entirely lost by vast numbers of urban dwellers. Modern science has recently become highly interested in natural remedies for many human diseases, yet continues to ignore the way in which indigenous languages contain perceptions, ideas, solutions to problems that are the very essence of the sustainability of human life.

Biocultural diversity - a complex of biodiversity, cultural diversity and linguistic diversity - is essential for the survival of any ecosystem because it permits the mix of characteristics of stability, adaptability and creativity, of resilience and transformability that are prerequisites for sustainability. In the same way as in agriculture, monocultures - whether they are social or linguistic - are inevitably weak and in constant danger of

extinction. Any form of individual and collective life depends on a complex and delicate web of relationships and its evolution depends on the diversity that is the basis of adaptability. Uniformity creates inflexibility and inability to adapt. Diversity allows cross-fertilization that leads to the strengthening of existing varieties and the emergence of new varieties. The loss of diversity undermines the chances of survival not only of individual environments, but of life itself.

Thus the issue of sustainability is closely linked both to the diversity and the vitality of languages. Linguistic diversity should be considered part of the global biocultural diversity of an ecosystem, of which every society, as well as the entire world, is an example, a network of dynamic and open relationships. Damage to a part of the network can cause unpredictable consequences for the entire system. If diversity is a necessary factor for the evolution of ecosystems and the strongest are those with more diversity, then the death of a language is a great loss because we lose an important example of the essential condition of life, of a possible world, of the ability developed by different peoples to adapt to their environment and construct ways of finding solutions to the problems it poses.

The sustainability and the vitality of a language are directly interdependent (Karan, 2012). Demographic factors are particularly significant for language vitality, in particular the numerical consistency and birth rate of its users, its geographical distribution and spatial concentration. At the same time, the status of a language can be a very influential variable, ranging from extremities of positive to negative perception along a polar continuum, which may confer a universally recognized prestige or even create a sense of shame in the user because of a sense of alleged inferiority (Harmon, 1995). More generally, the vitality of the group of users of a language is in itself very important, the individual and collective self-esteem that can derive from membership of that group on the basis of economic, social, historical and cultural variables. At the same time, institutional support together with self-organization and the promotion of their language by groups of users can also be important factors of vitality.

The vitality of a language is, however, always subject to change. Within the history of human language, many extremely vital and prestigious languages have become extinct, or rather given rise to new generations of languages. Previous and current dominant languages, such as Latin or English, are subject to the same kind of linguistic mortality as all languages. At the same time, all languages, including English, are subject to the same limits of codificability as any other language, thereby furnishing certain ways of doing things with words while excluding innumerable others. The particular paradox of English as a world language today is that its growing transformation due to cross-fertilisation processes provoked by a multitude of diverse users is, on the one hand, enriching for the characteristics and potential of the language system but, on the other hand, an inevitable tendency to monoculture with all the concomitant risks for the system itself and all those who use it.

5. Personal multilingualism

If environmental multilingualism is of vital significance for the sustainability of the global human enterprise, the personal multilingualism of people who constantly alternate the use of different languages during the activities that constitute their lives must also be considered as of equal importance. Personal multilingualism is in the first place an enrichment of the relationship between language user(s) and language(s) used, between signifiers, signifieds and processes of meaning making, between mental schemata and knowledge

building. Linguistic codificability is at one and the same time both the facilitator of cognitive structures and the bottleneck that constrains mental representations within the modes of input-output typical of natural language as both biophysical process and biocultural product. Moreover, the frames of reference of single language systems heavily condition our mental activity, influencing, for example, the construction of spatial, temporal or agency relationships and the way in which we reason about them and employ them in our action. Different frames of reference possess diverse logical properties and determine the development of our cognitive maps. Being multilingual means being able to use alternative ways of thinking, organising thought, of perceiving and representing the world, of reflecting on and acting in that world.

In recent years many questions have been posed about the cerebral organisation and the neural representation of different languages in multilingual people (Kovelman et al. 2008). One hypothesis posits the existence of a single extended system that is the sum of the constitutive elements of the different languages comprised. Another hypothesis posits a multilingual competence based on an organisation of different and separate systems and of different phonological, morphological and syntactic representations. Some hypotheses posit systems that are in part overlapping with common features and in part separate or the existence of sub-systems underlying one overall system with different but connected neural circuits. It would seem, however, that processing different languages involves the same areas and the same cerebral tissues, but that in the multilingual brain there is more activity in the right hemisphere and in particular in the prefrontal dorso-lateral cortex, responsible for the functions of control and attention.

It is hypothesized that the presence in the brain of different systems of representation contained by different languages, constantly active and potentially available at any moment, gives rise to a mechanism used to resolve the potential conflict between systems and manage appropriately the relationship between signifiers and signifieds within the system(s) in use. This mechanism is linked to a general capacity for executive control. In this way, personal multilingualism creates advantages at the level of attention capacity and operations involving selection, on which depend the ability to evaluate options and make choices as well as the processes of inhibition of stimuli or connections that could interfere with concentration and procedural realization of choices. These are all fundamental characteristics of the cerebral system of executive functions localized in the prefrontal cortex (Bialystock, Craik, Green, Gollan, 2009, Kroll, Rossi, 2013).

The need to constantly employ the conflict management strategies typical of the multilingual brain strengthens its functioning and promotes a functional neural architecture which stimulates global cognitive growth. Managing on a daily basis two or more language systems requires constant attention to what it is important to concentrate on, what to eliminate, what to put on stand-by, exercising an inhibiting control, ignoring distractions and misleading pathways. A multilingual brain is more secure in affronting complexity, more able in managing simultaneous tasks, carrying out rapidly operations, activating and processing multiple categories, adopting and maintaining alternative points of view and perspectives, focusing on specific aspects without losing sight of overall issues. If there is an urgent need to change ”current development paradigms and patterns … [in favour of] … sustainability transitions … [that] … require radical, systemic shifts in deeply held values and beliefs, patterns of social behavior, and multi-level governance and management regimes … [together with the] need to harness human creativity and innovation potential” (Westley et al. 2011), then

multilingual brains, both in terms of the individuals who reflect and act in the world and the discourses in which they participate and contribute to, are an essential part of this transformation.

A further related aspect of the potential benefits of personal multilingualism is that the same executive functions it enhances are also the cognitive processes that deteriorate in old age and there is a growing literature that demonstrates a positive effect of multilingualism on executive control processes throughout life. Various studies show how multilingualism can have a positive impact on the aging process through a strengthening of executive functions and working memory, extend many cognitive functions that support both activity and creativity, inhibit degenerative processes and the onset dementia (Craik, Bialystock, Freedman, 2010). In this sense, personal multilingualism is increasingly seen as an important investment in the level of health and well-being of populations and consequently in the sustainability of expenditure on social and health systems.

6. Conclusions

Different language systems necessarily determine the very nature of how we use language to reflect on and act in the world, our processes of building knowledge, understanding and interpreting, narrating, describing, representing, re-elaborating, explaining, arguing, analysing, evaluating, formulating hypotheses and predictions, experimenting, carrying out operations, elaborating products. People who use languages with different characteristics think differently, in terms of the mental constructs and operations made possible by different morphologies and syntaxes, or even more radically different ways of giving structure to human language and thought.

Human, like all biological, evolution has always depended on a process of adaptive radiation in which a lineage rapidly diversifies, with the newly formed lineages evolving different adaptations. Language has always been an essential accompanying part of this process. Different factors may trigger adaptive radiations, but each is a response to an opportunity and each language enables that response and our capacity to recognize and exploiting opportunities. Losing diversity, in terms of both environmental and personal multilingualism, means losing both opportunities and responses, running "the risk of a monolingual mindset" (Tomkin, 2011, Phillipson, 2011).

Language diversity is not a cause, but rather a concomitant feature, of evolutionary resilience and transformability. Losing languages means losing a part of human vitality. Language mortality is both a depletion of our existing knowledge store and an impoverishment of our knowledge-building capacity. The issue is not about the sustainability of given human languages but that of the sustainability of human trajectories. Promoting environmental and personal multilingualism is essential if we are to "innovate sufficiently rapidly and with sufficient intelligence to transform our system out of a destructive pathway and into one that leads to long-term social and ecological resilience" (Westley et al. 2011).

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